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Title: STATOR OF ROTARY ELECTRIC MACHINE
AND METHOD FOR MAKING THE SAME

VERIFIED TRANSLATION OF PRIORITY DOCUMENT

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[Designation of Document] Specification

[Title of the Invention] STATOR FOR ELECTRIC ROTARY MACHINES AND METHOD OF MANUFACTURING THE SAME

[Claims]

[Claim 1]

A stator for electric rotary machines, provided with:

a stator core having a plurality of slots which respectively have a plurality of wire holding positions lined up in the radial direction, the slots formed at a set interval from each other along the circumference of the stator core, and

a multiphase stator winding comprising plural phase windings each of which forms one coil having straight portions held in the slots, and end turns extending from both end sections of each straight portion to the straight portions in two slots of the same phase, all three spaced from each other by a pitch close to that between NS magnetic poles of the rotor, characterized in that:

the stator winding is made of plural divided multiphase windings each comprising a plurality of windings of different phases, each of which occupy each two adjacent wire holding positions,

a phase winding is made of a continuous wire,

plural phase windings included separately in each of the divided multiphase windings and having the same phase being connected together in series or in parallel outside the stator core,

both ends of the end turns being connected separately

to two straight portions in different conductor holding positions.

[Claim 2]

A stator for electric rotary machines according to Claim 1, wherein:

the two end turns connected at the side of the same end of the stator core to two straight portions adjacent to each other in the radial direction in the same slot and included in the same phase winding are connected at their other ends separately to other slots opposite each other in the circumferential direction.

[Claim 3]

A stator for electric rotary machines according to Claim 2, wherein:

each of the end turns has:

a central section where the radial distance from the center of the core changes step-wise, and a pair of half sections bordering the central section on each side,

one of the two half sections being disposed so that one is displaced in the radial direction with respect to the other by a distance substantially equal to a thickness of the end turn in the radial direction,

the radial inner half section of the end turn of a particular phase crosses with the radial outer half section of the end turn of another phase, and

the radial outer half section of the end turn of the first-mentioned phase crosses with the radial inner half

section of the end turn of the second-mentioned phase.

[Claim 4]

A stator for electric rotary machines according to any one of Claims 1 to 3, wherein:

each of the phase windings is one wire continuous from a wind starting portion thereof to a wind finishing portion thereof.

[Claim 5]

A stator for electric rotary machines according to any one of Claims 1 to 4, wherein:

each of the phase windings has a substantially circular cross section.

[Claim 6]

A stator for electric rotary machines according to any one of Claims 1 to 5, wherein:

the slots are formed adjacent to each other along the circumference and have a plurality of conductor holding positions at the same radial distances in which the straight portions of the plural phase windings of the same phase are held.

[Claim 7]

A stator for electric rotary machines according to any one of Claims 1 to 6, wherein the circumferential width of each of the slots is set smaller than a width of a tooth of the stator core.

[Claim 8]

A method of manufacturing a stator for electric rotary machines, which is provided with a stator core having

a plurality of slots, and multiphase stator windings held in the slots, characterized in that the method includes:

a step of making a plurality of divided multiphase windings each having a multiplicity of phase windings each of which is formed by connecting straight portions and end turns together,

a step of reducing the diameter of the divided multiphase windings and setting the resultant divided multiphase windings in inner circumferential side rotor holding cavities of the stator core, inserting the straight portions of the diameter-reduced divided multiphase windings from the openings of the slots into the interior of the slots, and thereby arranging in order the straight portions of the divided multiphase windings into the interior of the slots, and

a step of connecting together in series the windings of the divided multiphase windings of the same phase.

[Claim 9]

A method of manufacturing a stator for electric rotary machines according to Claim 8, wherein the method further includes:

a step of plastically deforming free ends of teeth adjacent to the openings of the slots after the straight portions of the multiphase stator windings are inserted into the slots, and thereby narrowing the openings of the slots.

[Detailed Description of the Invention]

[0001]

[Technical Field to Which the Invention Belongs]

This invention relates to a stator for electric rotary machines and the like mounted on a passenger car, a truck, a ship, etc.

[0002]

[Related Art]

In recent years, attaining the miniaturization of an electric rotary machine, such as an AC generator for vehicles and an increase in an output therefrom and operation efficiency thereof while holding down an increase in the manufacturing cost has been demanded with respect to the development of engines with reduced idling speed as a measure to deal with environmental problems, the reduction of the weight of a vehicle for improving the fuel consumption, and the narrowing of engine room for securing an interior space of a vehicle. Moreover, in the engine room electrolytes, car shampoo, brine, and other extraneous matter often enter. Therefore, it is also important to secure the insulation of stator windings in an electric rotary machine, such as an AC generator for vehicles.

[0003]

A structure meeting these demands is disclosed in JP-A-11-299153, in which a proposal to miniaturize coil ends to heightening the insulation reliability of the structure, reducing in the stator winding shaping step the chances that imperfect insulation due to the contacting of end turns at the ends of the coil will occur.

[0004]

According to this structure, the bare wires of coils

drawn out from slots are folded back at the intervals between slots toward the inner circumferential side, and drawn into the slots which are several slots away in one of circumferential directions, the folded-back portions of the wires being thus arranged in order in the circumferential direction.

[0005]

The Patent No. 2927288 owned by the applicant of this invention discloses an AC generator for vehicles, capable of attaining miniaturization owing to a high space occupying factor, and also high output and high efficiency by forming stator windings using a plurality of conductor segments, and preventing the interference of the conductor segments at the coil ends.

[0006]

[Problem to Be Solved by the Invention]

However, the coil end structure of the stator winding disclosed in the former publication is capable of preventing the interference of the element wires of the coils with each other at the coil ends as shown in Fig. 8 only when the element wires of the coils are thinned and the number of the element wires of the coils in the slots reduced. However, when an attempt is made at obtaining a high space factor by thickening the element wires of the coils so as to attain a high output and a high efficiency, the circumference of the element wires of the coils at and near the point of the fold increases. Therefore, preventing the interference of the element wires of the coils with each other at the coil ends becomes difficult.

Although the prevention of the interference of the element wires of the coils at the coil ends can, of course, be effected by increasing the diameter and axial length of the coil ends, it causes an increase in the dimensions of an electric rotary machine and thus an increase in the weight and resistance.

[0007]

The coil end structure of the stator winding disclosed in the latter publication has the following drawbacks. A multiplicity of conductor segments have to be bonded together, and, moreover, the adding of a step of insulating the bonded portions is needed, so that the manufacturing process becomes complicated.

[0008]

The present invention has been made in view of the above problems, and provides a stator for electric rotary machines which have attained the improvement of an output from an electric rotary machine owing to the reduction of body dimensions, weight and a resistance loss thereof with no increase in the number of manufacturing steps; and a method of manufacturing the same.

[0009]

[Means for Solving the Problem]

A stator (1) for electric rotary machines is provided with a stator core having a plurality of slots which have a plurality of conductor holding positions respectively lined up in the radial direction, and neighboring slots formed at a set interval from each other in the circumferential direction of

the stator core, and a multiphase stator winding including a multiplicity of phase windings each of which forms one coil having straight portions held in the slots, and end turns extending from both ends of each straight portion which are connected to a pair of other straight portions in two slots of the same phase all three spaced from each other by a pitch close to that between NS magnetic poles of the rotor, wherein:

the stator winding is made of a plurality of windings of different phases, parts of which occupy adjacent conductor holding positions in one slot, each phase winding being made of one continuous wire, the plural phase windings including separately the divided multiphase windings, and the plural phase windings having the same phase being connected together in series or in parallel on the outer side of the stator core, the two ends of the end turns being connected respectively to different conductor holding positions.

[0010]

Namely, according to this structure, the stator winding is divided into a plurality of divided multiphase windings, and one divided multiphase winding is held in two conductor holding positions which are radially adjacent to each other in the slots. Therefore, it is possible to improve the insulating reliability of the structure by preventing the interference of the end turns of the coil ends with each other without enlarging the coil ends, and attain a high space factor of the slots with ease.

[0011]

According to this structure, each phase winding is formed of a continuous wire, so that the simplification and the improvement of the reliability of the bonding step can be attained. The "phase winding is formed of a continuous wire" referred to above means that at least three continuous straight portions of a phase winding are formed by using a single conductor wire without any joints.

[0012]

The stator of Claim (2) for electric rotary machines is in accordance with the stator of Claim (1) above, in which the two end turns connected at one end of the stator core to two straight portions radially adjacent to each other in the same slot and included in the same phase winding extend respectively in circumferentially opposite directions.

[0013]

According to this structure, one end of each end turn is connected to a radially inner straight portion and the other end is connected to a radially outer straight portion, so that the spatial interference of the end turns with each other at the coil ends is prevented easily.

[0014]

A stator (3) for electric rotary machines is in accordance with the stator (2) above, in which each of the end turns has a central section where the distance from the radial center changes step-wise, and a pair of half sections bordering on the central section, one of the half sections being disposed so that one is displaced radially with respect to the other by

a distance substantially equal to a thickness of the end turn in the radial direction, the radial inner half section of the end turn of an particular phase crossing with the radial outer half section of the end turn of another phase, and the radial outer half section of the end turn of the above first phase crossing with the radial inner half section of the end turn of the other phase.

[0015]

Thus, according to this structure, one half section of each end turn connected to the straight portion in the conductor holding position on the radial outer side of the slot projects at one coil end along the circumference in one direction and away from the core in the axial direction while staying at the same radial distance, and reaches the central section of the end turn. The two ends of the central section of each end turn have a difference in distance from the radial center which is at least the radial width of the end turn. Therefore, the outer half section of each end turn can be the minimum required distance from the straight portion in the conductor holding position on the radially inner side of the end turn without spatially interfering with the half sections other end turns.

[0016]

In other words, the half sections to one side of the end turns are provided in parallel to each other in positions of a radial distance substantially equal to that of the radially outer straight portions, while the other-side half sections of

the end turns are provided in parallel to each other in positions of a radial distance substantially equal to that of the radially inner straight portions. Therefore, the end turns do not spatially interfere with each other, and can be formed to a shape of a required minimum area. This enables the coil end to be miniaturized and the total length of the coil end to be reduced.

[0017]

A stator (4) for electric rotary machines is in accordance with any of the stators (1) to (3) above, in which each of the phase windings is one continuous wire extending from a wind starting end thereof to a wind finishing end thereof.

[0018]

According to this structure, the manufacturing cost can be lowered by reducing the number of bonded portions to a greatly low level as compared with that of the bonded portions of the electric rotary machine disclosed in the second-mentioned publication.

[0019]

A stator (5) for electric rotary machines is in accordance with any of the stators (1) to (4) above, in which each of the phase windings has a substantially circular cross section.

[0020]

According to this structure, stress on, especially, a central section of each end turn is reduced, so that the reliability of the structure can be improved.

[0021]

A stator (6) for electric rotary machines is in accordance with any of the stators (1) to (5) above, in which the slots are formed along the circumference and with the radially same plural conductor holding positions in which the straight portions of the plural phase windings of the same phase are held.

[0022]

According to this structure, the molding of the end turns and the assembling of the divided multiphase windings can be done easily.

[0023]

A stator (7) for electric rotary machines is in accordance with any of the stators (1) to (6) above, in which a circumferential width of each of the slots is set smaller than a width of a tooth of the stator core.

[0024]

According to this structure, the spatial interference of the central section of each end turn with other end turns comprising the coil end can be held down excellently.

[0025]

A method (8) of manufacturing a stator for electric rotary machines, which is provided with a stator core having a plurality of slots, and multiphase stator windings held in the slots, for electric rotary machines, wherein the method includes a step of making a plurality of divided multiphase windings each having plural phase windings each of which is formed by connecting straight portions and end turns together,

a step of reducing the diameter of the divided multiphase windings and setting them in inner circumferential side rotor holding cavities of the stator core, inserting the straight portions of the diameter-reduced divided multiphase windings from inner circumferential side openings of the slots into the interior of the slots, thereby arranging in order the straight portions of the divided multiphase windings into the interior of the slots, and connecting together in series the windings of the same phase of the divided multiphase windings.

[0026]

Owing to this method, a stator can be obtained which has better reliability because it prevents the interference of element wires with each other at the coil ends while attaining a high output and a high efficiency owing to a high space factor of the slots, and, moreover, greatly reduces the manufacturing cost by limiting the portions to be bonded together to only the terminal ends of phases of the divided multiphase windings.

[0027]

A method (9) of manufacturing a stator for electric rotary machines is in accordance with the method (8) above, in which the method further includes a step of plastically deforming free ends of teeth adjacent to the openings of the slots after the straight portions of the multiphase stator windings are inserted into the slots, and thereby narrowing the openings of the slots.

[0028]

This constitution enables a higher space factor to

be attained.

[0029]

[Mode of Embodying the Invention]

A preferred mode of an electric rotary machine for vehicles, using the stator according to the present invention will now be described.

[First Mode of Embodiment]

A first mode of example of an electric rotary machine for vehicles to which the present invention is applied will now be described with reference to Figs. 1 to 6.

[0030]

Fig. 1 is an axial half sectional view of an AC generator for vehicles to which the present invention is applied, Fig. 2 is a partial perspective view of an Xa phase of first three-phase windings, Fig. 3 a diagram of the specifications of the Xa phase of the first three-phase windings, Fig. 4 a partial plan view of an X-phase of the coil end seen in the axial direction, Fig. 5 sectional view of a portion of a stator, and Fig. 6 a schematic wiring diagram showing the spatial arrangement of coil ends of the first three-phase windings.

[0031]

This AC generator 1 for vehicles has a rotor 2, a stator 3, and a frame 4. The stator 3 has a stator core 32 which is wound with a stator winding 31 constituting a three-phase armature coil, and which is fixed to an inner circumferential surface of the frame 4.

[0032]

A shaft of the rotor 2 is mounted fixedly with a pulley 20, and a rotational force of an engine is transmitted to the rotor 2 through the pulley 20. When an exciting current is made to flow in this condition in a field winding 8 of the rotor 2 via slip rings 9, 10, magnetic poles are formed on field cores 71, 72 of the rotor 2. As a result, a three-phase AC voltage occurs in the stator winding 31. This three-phase AC voltage is rectified by a rectifier (not shown), and then outputted through an output terminal 6.

[0033]

Cooling fans 11, 12 fixed to the field cores 71, 72 generate cooling wind, which is taken into an inner portion of the frame 4 from an opening 41 provided in an end wall thereof, and which is discharged from an opening 42 provided in a circumferential wall of the generator to the outside.

[0034]

As shown in Fig. 5, the stator winding 31 includes two three-phase windings 31a, 31b held in each of a predetermined number of slots 35 of the stator core 32 via insulators 34 respectively, and the windings of the same phase out of the three-phase windings 31a, 31b are connected together in series. More concretely, X-phase windings of the stator winding 31 are formed by connecting together in series Xa-phase windings constituting X-phase windings of the first three-phase windings 31a, and Xb-phase windings constituting X-phase windings of the second three-phase windings 31b held in the same slots 35 as the Xa-phase windings. The Y-phase and Z-phase

windings of the stator windings 31 are also formed in the same manner.

[0035]

The Xa-phase windings of the 3-phase windings 31a will further be described with reference to Fig. 2.

[0036]

Each of the Xa-phase windings of the three-phase windings 31a include a straight portion 311a provided in the X-phase slot 35 and a pair of coil ends 312a connected to both ends of the straight portion 311a and provided on both of axial sides of the stator core 32, the Xa-phase windings being formed by continuous wires.

[0037]

In a slot for X-phase, the straight portion 311a has an outer layer 31a1 on the radially outer side (deeper side of the interior of the slot 35) in the same slot, and an inner layer 31a2 on the radially inner side (toward the opening of the slot). The outer layer 31a1 and inner layer 31a2 are staggered from each other in the radial direction by a distance corresponding to the radial thickness of the straight portion 311a as shown in Fig. 4. Although the Xa-phase winding of the three-phase windings 31a and Xb-phase winding of other three-phase windings 31b are shown as phase windings having a substantially circular cross section in Fig. 4, the cross-sectional shape of these phase windings is not limited thereto. This cross-sectional shape may, of course, be set to a flat rectangular shape for the purpose of, for example, improving the space factor of the

slots.

[0038]

The coil end 312a includes a predetermined number of end turns 312c, and both ends of each end turn 312c are connected to the same side end sections of the outer layer 31a1 and inner layer 31a2 held separately in a pair of slots 35 for X-phase which are separated from each other by a pitch corresponding to that between NS magnetic poles of the rotor 2. The coil end 312a is plastically deformed (twisted) at a central section of the end turn 312C as shown in Fig. 4, and so given a shift in distance from the radial center substantially equal to a difference in radial positions of the outer layer 31a1 and inner layer 31a2 (i.e., a distance corresponding to the radial thickness of the straight portion 311a). As is understood from Fig. 4, this stepped portion is adjacent to one tooth of the stator core 32.

[0039]

The Xa-phase winding of the three-phase winding 31a is extended so as to make one revolution from a wind starting end portion 3120, and then wound a second time in an order reverse that of the first turn via a non-twisted end turn 312d as shown in Fig. 2, the winding finally reaching a wind finishing end portion 3121. An illustration of the specifications of the Xa-phase winding of the three-phase winding 31a is shown in Fig. 3. Referring to Fig. 3, a solid line shows the outer layer 31a1, and a broken line the inner layer 31a2. The straight portion 311a of the X-phase winding of this three-phase winding 31a is

held in a radial two-layer-superposed state in the slot 35 for the X-phase. Similarly, a Ya-phase winding and a Za-phase winding of the three-phase winding 31a are formed in positions staggered from each other at an electrical angle of 120° each.

[0040]

The Xa-phase, Ya-phase and Za-phase windings made as mentioned above are formed in one body into a first substantially cylindrical three-phase winding 31a. These Xa-phase, Ya-phase and Za-phase windings do not spatially interfere with one another at the coil end (312a in the case of the Xa-phase winding). The matter will be described below with reference to Fig. 6 schematically showing the coil end of the three-phase winding 31a. Referring to Fig. 6, the straight portions of the Xa-, Ya- and Za-phase windings of the three-phase windings 31a shall be represented by 311, coil ends 312 and the end turns of the coil ends 312c, and each end turn 312c has a radially inner half section a and a radially outer half section b bordering on the central part (twisted part) of the end turn 312c.

[0041]

As shown in Fig. 6, the radially inner half section a and radially outer half section b of the end turns 312 of the Xa-, Ya- and Za-phase windings are arranged so that the half sections a do not spatially interfere with each other; the half sections b do not spatially interfere with each other; and the half section a and half section b do not spatially interfere with each other.

[0042]

At the same coil end, the half sections a of the end turns are extended axially and circumferentially in parallel with each other keeping a predetermined clearance, and each end turn is given a radial height difference at the central section thereof. The central sections of the end turns are arranged so that the central sections are spaced circumferentially away from each other via a predetermined clearance.

[0043]

This enables the coil ends to be miniaturized and the total length of the coil ends to be reduced without causing the end turns to spatially interfere with (contact) each other,.

[0044]

Outside the stator core, the radially inner straight portion and radially outer straight portion of the winding of a particular phase can be placed in a radially separated state, so that it is preferable to combine the phase winding x and winding y of other phase with each other by utilizing these characteristics. Besides such techniques, a divided multiphase winding can also be made with a row of three to six long conductors arranged in parallel with one another at intervals close to the distance between two slots, by bending at once all the conductors at the centers of the end turns, thereby forming straight portions and end turns sequentially, and finally rounding the resultant straight portions and end turns to fit around the core, thus forming divided multiphase windings.

[0045]

The straight portion (311a in the Xa-phase winding) of the substantially cylindrical three-phase winding 31a thus formed has a diameter equal to that of the conductor holding portion in the slot 35, and cannot be held as it is in the stator core 32. However, the substantially cylindrically molded first three-phase winding 31a has many pores and elasticity. Therefore, the diameter of this three-phase winding in the circumferential direction is reduced by elastically deforming the same winding outward in the radial direction, and the three-phase winding in this condition is forced axially into the interior of the stator core 32. Each straight portion (311a in the Xa-phase winding) may thereafter be inserted into the slot by this spring-back.

[0046]

In this embodiment, the claws 322 to be extended from the teeth 321 on both sides of the slot toward the opening of the slot 35 are formed in advance initially projecting in the radially inward direction, and the width of the opening of the slot 35 is thereby secured.

[0047]

The Xb-phase winding, Yb-phase winding and Zb-phase winding of the second three-phase winding 31b are then made in the same manner, and held in the slot 35. The opening of the slot 35 is then narrowed by elastically deforming the claws 322 in the direction in which the opening of the slot 35 is closed.

[0048]

During the plastic deformation of the claws 322, an electric current may be supplied to object portions thereof in a concentrated manner. The plastic deformation operation may thus be facilitated.

[0049]

A wind-finishing end portion 3121 of the Xa-phase winding is then bonded to a wind-starting end portion of the Xb-phase winding in the same slot to complete an X-phase winding. The Y-phase winding and Z-phase winding are completed in the same manner. These X-, Y- and Z-phase windings are connected together in the shape of a star or in the shape of a delta to form a three-phase armature winding 31 having four straight portions per slot.

[0050]

(Advantage and Effect)

According to this mode of embodiment described above, the coil ends of the phase windings (Xa-phase, Ya-phase, Za-phase, Xb-phase, Yb-phase and Zb phase) forming the three-phase windings 31a, 31b are arranged by using continuous wires whose coil ends are prevented from spatially interfering with each other. Therefore, the reduction of the body dimensions, weight and resistance loss of the stator owing to the miniaturization of the coil ends can be attained with the bonding process simplified greatly.

[0051]

Owing to the employment of slots the openings of which are narrowed after the above-mentioned coils are held therein,

a high space factor can be attained.

[Second Mode of Embodiment]

Although, in the above-described first mode of embodiment, the windings were arranged radially in one row and in four stages in the slot 35, two straight portions may be held in each slot 35 adjacently in the circumferential direction in the same stage (layer) 35 as shown in Fig. 7. Fig. 7 shows the X-phase only.

[0052]

In this case, these two adjacent coils are substantially the one coil as in the first mode of embodiment which has been divided, and the attainment of the three-phase armature winding 31 is, of course, possible the reasons for which do not need to be given.

[0053]

Referring to Fig. 7, for example, inner portions 100, 101 constituting two circumferentially adjacent straight portions in a particular slot 35 are connected to two circumferentially adjacent straight outer portions 102, 103 in another slot 35 which is removed from the mentioned slot 35 by one pole pitch, and deformed radially at end turns 312C' of the coil end 312' in the same manner as mentioned above.

[Other Modes of Embodiments]

In the above-described first mode of embodiment, the opening of the slot is narrowed by elastically deforming the claws after the windings are held in the slot. It is also possible that the space factor be secured without carrying out

such an elastic deformation of the claws as mentioned above, by inserting such one thick wire as shown in Fig. 2 which is formed of a plurality of thin wires which can be entered into the narrow opening of a slot successively.

[0054]

The circumferential width of a tooth of a stator core may be set larger than that of a slot 35. When the circumferential width of the tooth is set in this manner, the circumferential width of an end turn becomes smaller than that of the tooth. This enables the distance between an end turn of one phase winding and that of another phase winding to be secured, and inconveniences such as short-circuiting between phase windings can be prevented effectively. The number of the phase windings in a slot can, of course, be increased in accordance with the required characteristics. For example, third and fourth three-phase windings can be added to such first 3-phase windings 31a and second three-phase windings 31b as are used in the first mode of embodiment, in the same manner as the first and second phase windings.

[0055]

In the second mode of embodiment, two straight portions are provided in the same stage (layer) in the interior of each slot. Even in the case where three or more straight portions are provided in the same stage (layer) in the interior of each slot, the same effect as mentioned above can be obtained by employing the same structure as in the second mode of embodiment.

[0056]

Alternatively, the stator winding may also be formed by setting such four three-phase windings (X-phase windings only are shown in Fig. 7 as already mentioned) as shown in Fig. 7 to be the first three-phase windings, forming second three-phase windings the mode of which is identical with that of the first three-phase windings, arranging these first and second three-phase windings on the stator core in the same manner as in the first mode of embodiment, and then connecting the windings of the same phase together in series. In this case, the third three-phase windings and onward can also be arranged in the same manner. Moreover, multiphase windings of not smaller than three-phase windings may also be used. The number of the slots is not limited to thirty-six, but can, of course, be changed in accordance with the number of the magnetic poles of the rotor.

[Brief Description of the Drawings]

[Fig. 1] A sectional view of a half of an AC generator for vehicles in a first mode of embodiment of the present invention.

[Fig. 2] A partial perspective view of an Xa-phase of first three-phase windings on a stator of the first mode of embodiment.

[Fig. 3] A diagram of the specifications of the Xa-phase of the first three-phase windings on the stator of the first mode of embodiment.

[Fig. 4] A partial plan view, which is taken in the

axial direction, of the coil ends on the stator of the first mode of embodiment.

[Fig. 5] A partial sectional view of the stator of the first mode of embodiment.

[Fig. 6] A schematic wiring diagram showing the spatial arrangement of coil ends of the three-phase windings in the first mode of embodiment.

[Fig. 7] A partial plan view taken in the axial direction of the coil ends on the stator of a second mode of embodiment.

[Fig. 8] A partial plan view, taken in the axial direction, of coil ends of a related art stator.

[Description of the Reference Numerals]

1	AC GENERATOR FOR VEHICLES
2	ROTOR
3	STATOR
31	STATOR WINDING
31a	FIRST THREE-PHASE WINDING
311a	STRAIGHT PORTIONS
312a	COIL ENDS
312c	END TURNS
31b	SECOND THREE-PHASE WINDING.

[Designation of Document] Specification

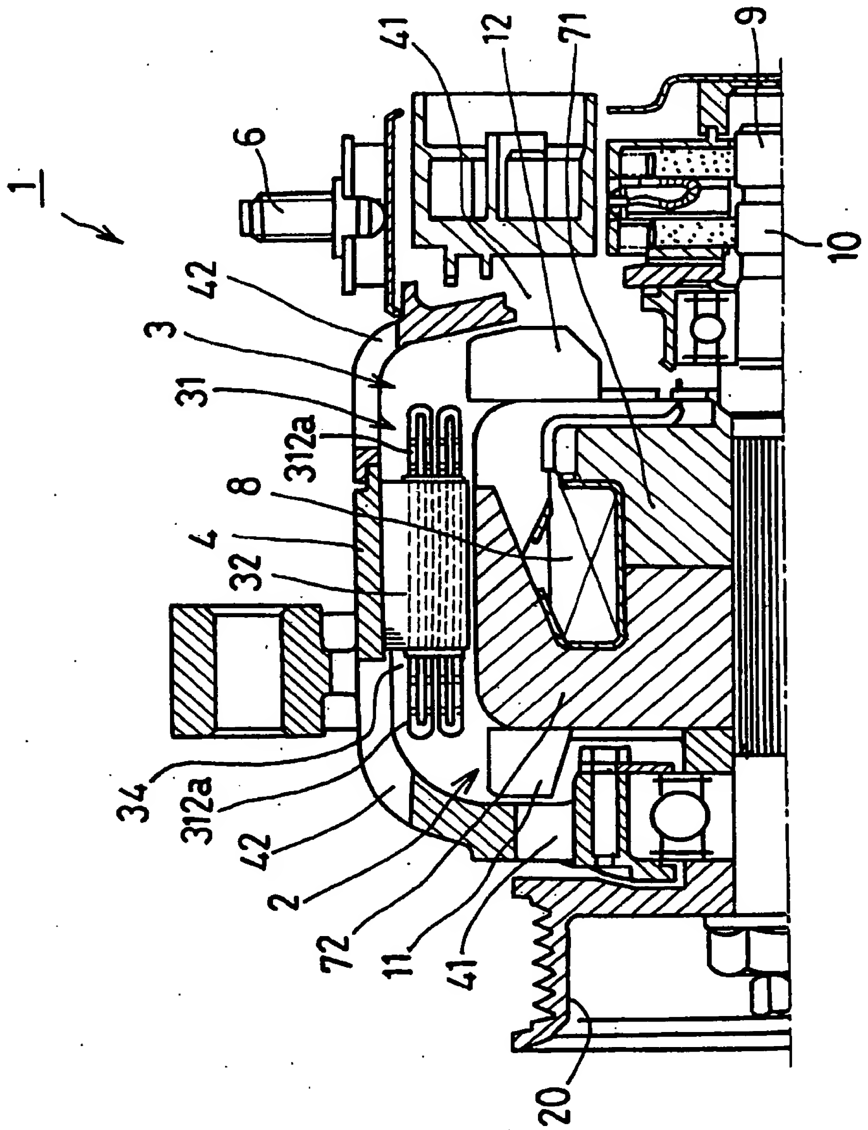
[Abstract]

[Problem] To provide a stator for electric rotary machines, which has attained the improvement of output owing to the reduction of body dimensions, weight, a resistance loss reduction, and inductance leakage reduction with an increase in the manufacturing steps held down; and a method of manufacturing the same.

[Means for Resolution] A stator winding is divided into two divided multiphase windings Xa, Xb, and one divided multiphase winding Xa is held in two radially adjacent conductor holding positions. This enables the interference of end turns of coil ends with each other to be prevented without enlarging the coil ends, and the insulating reliability of the stator to be thereby improved. Moreover, it is possible to easily attain a high space factor of the slots.

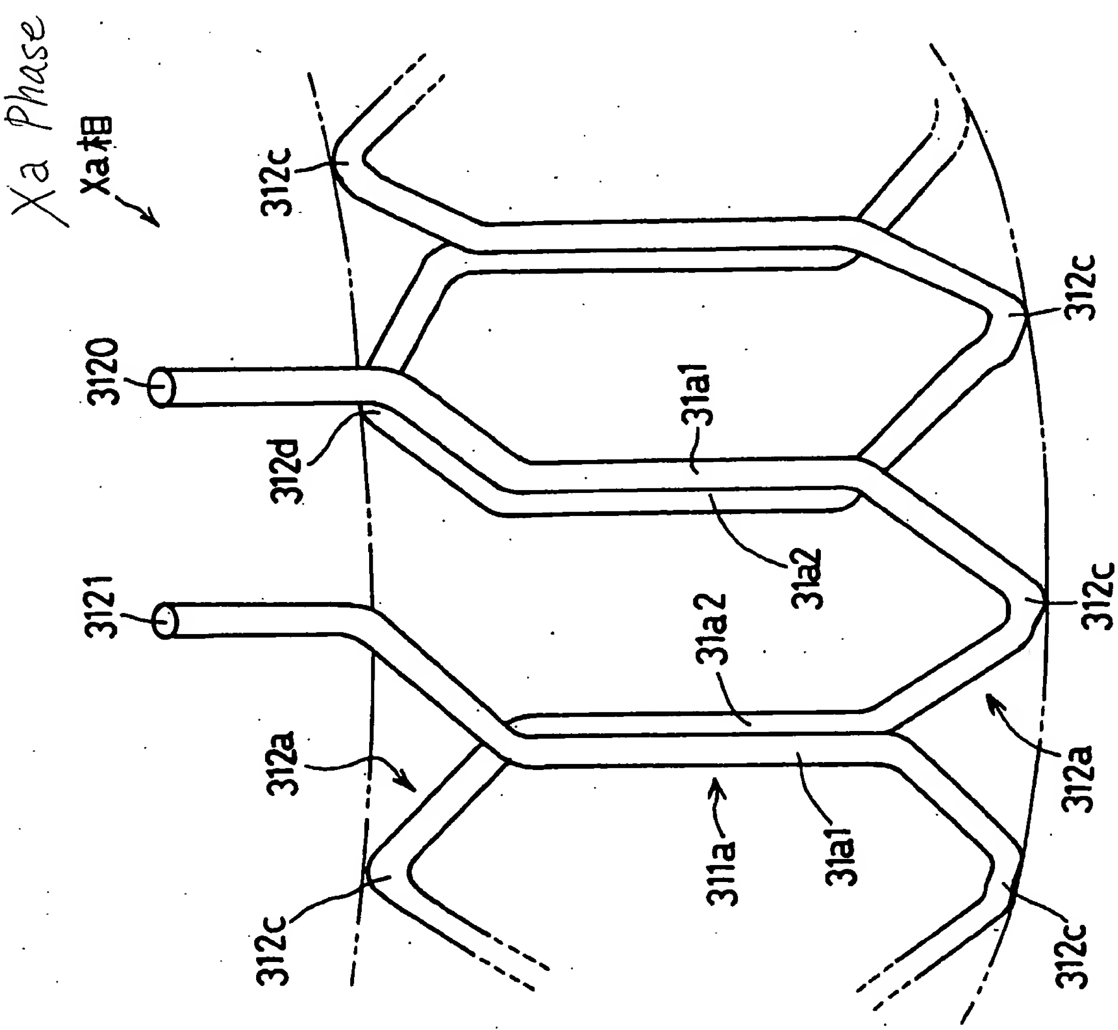
[Selected Drawing] Fig. 4

【書類名】　図面
Document　Drawings
【図１】
Fig. 1



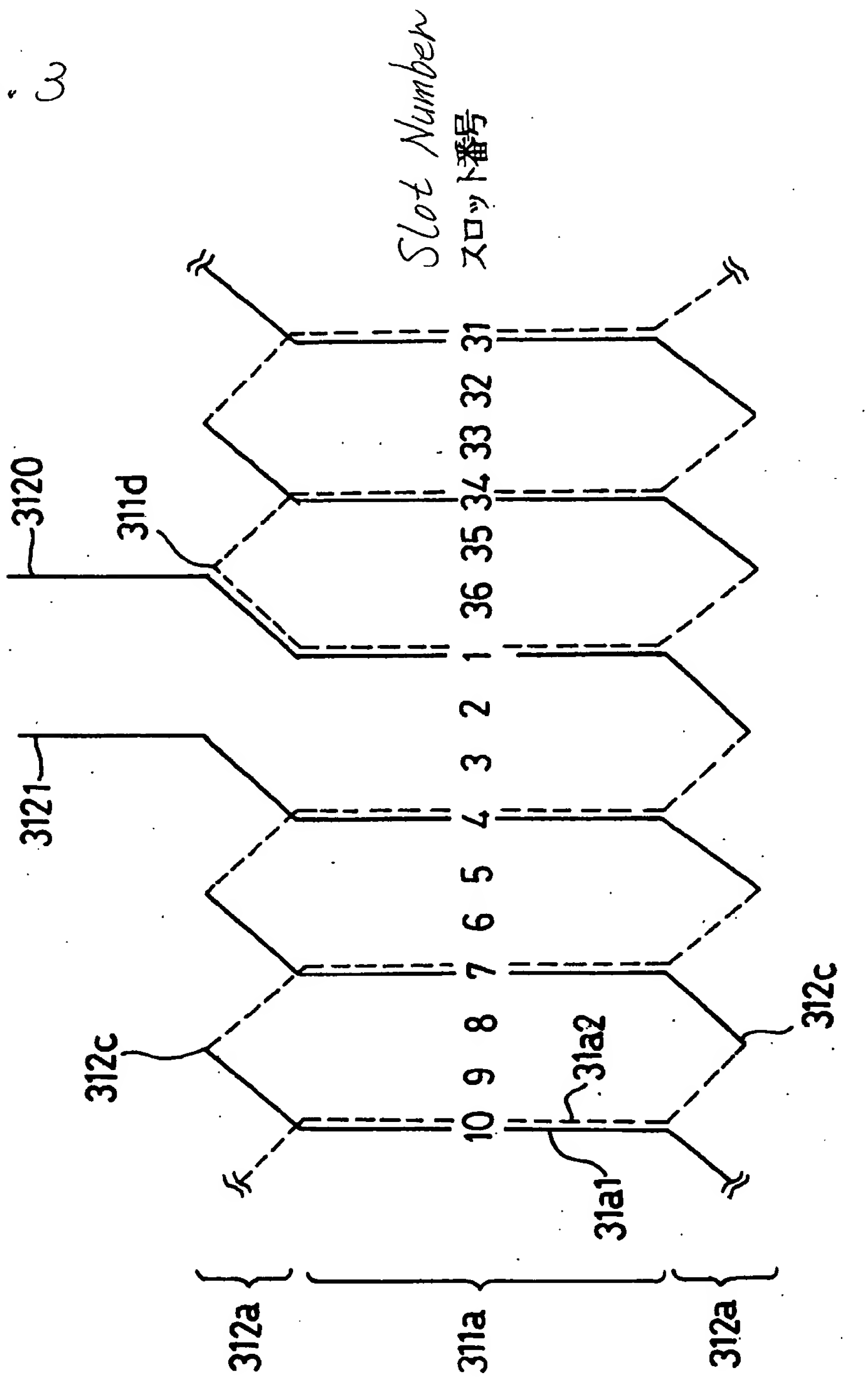
【図２】

Fig. 2


Xa Phase
Xa相
312c
3120
312d
3121
312a
31a1
31a2
31a2
31a1
311a
312c
312c
312a
312c

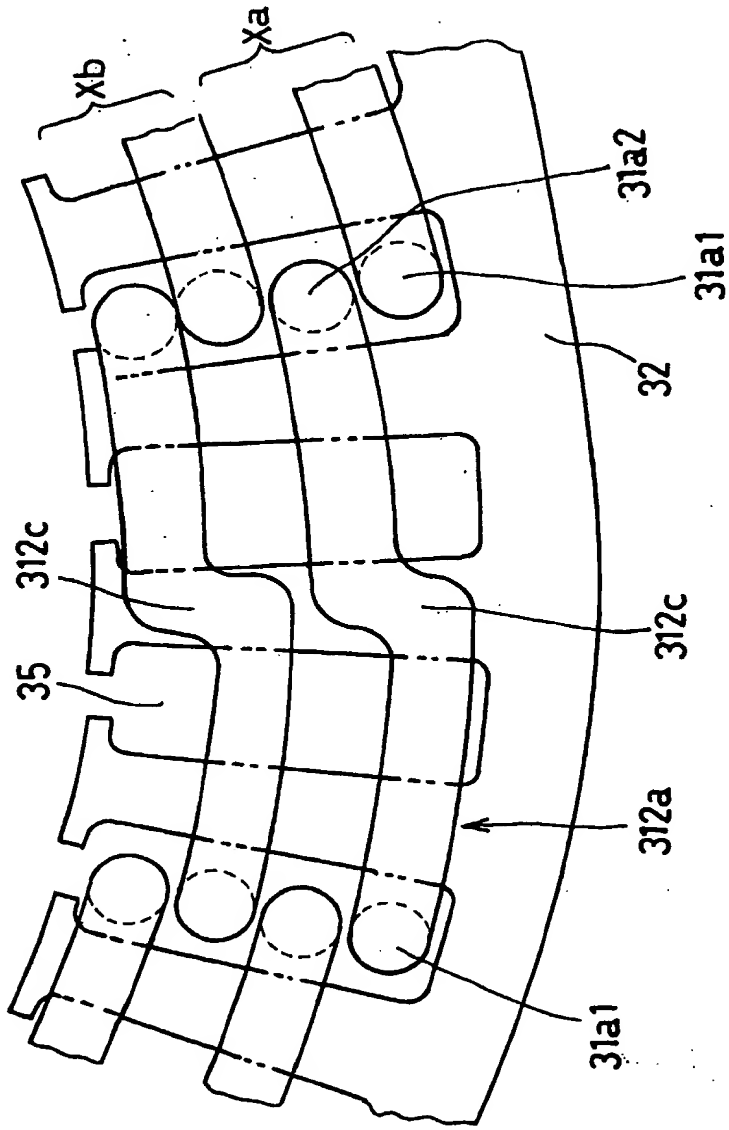
【図３】

Fig. 3


Slot Number
スロット番号
31
32
33
34
35
36
1
2
3
4
5
6
7
8
9
10
3120
311d
3121
312c
312c
31a2
31a1
312a
311a
312a

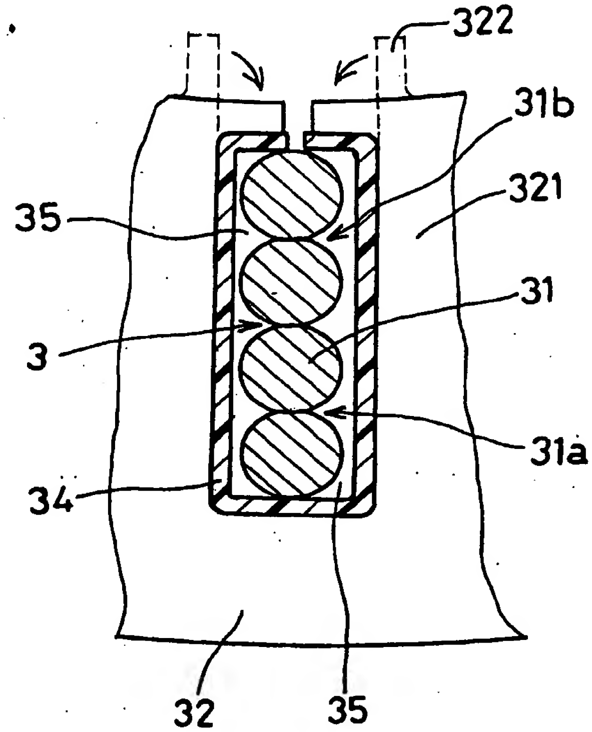
【図４】

Fig. 4



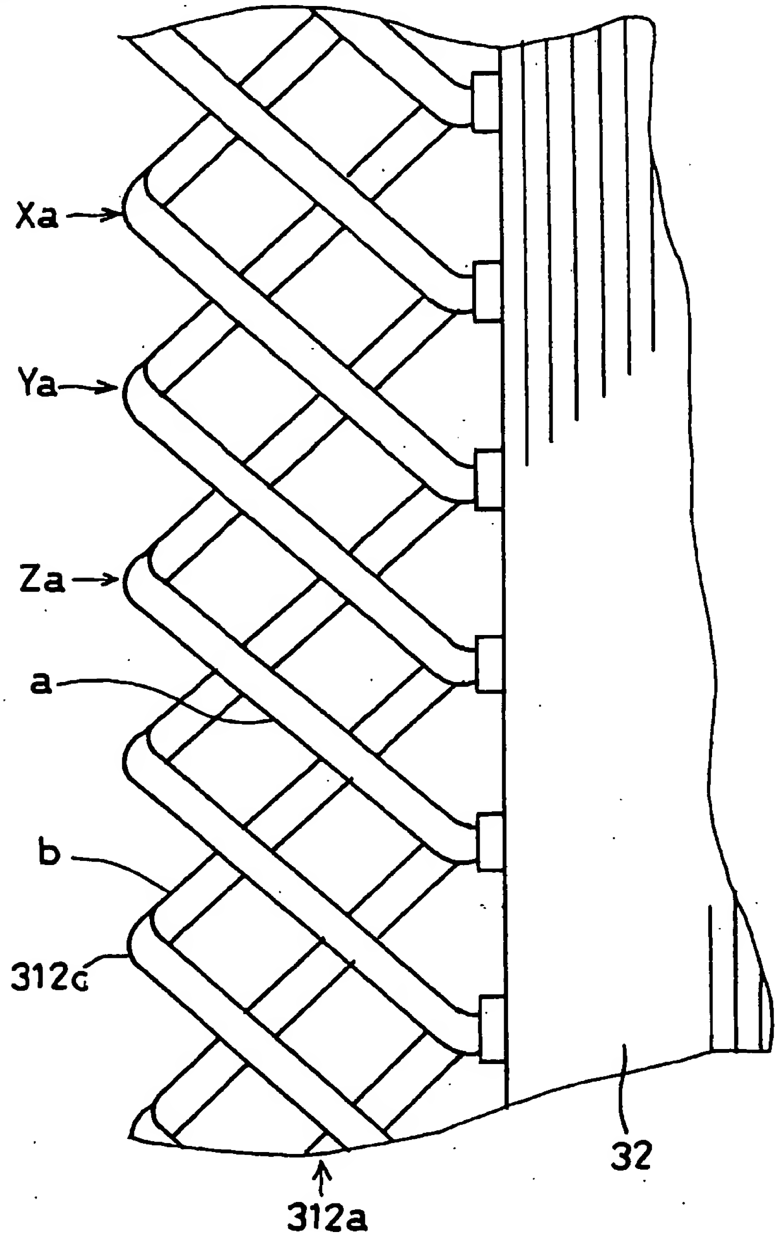
【図５】

Fig. 5



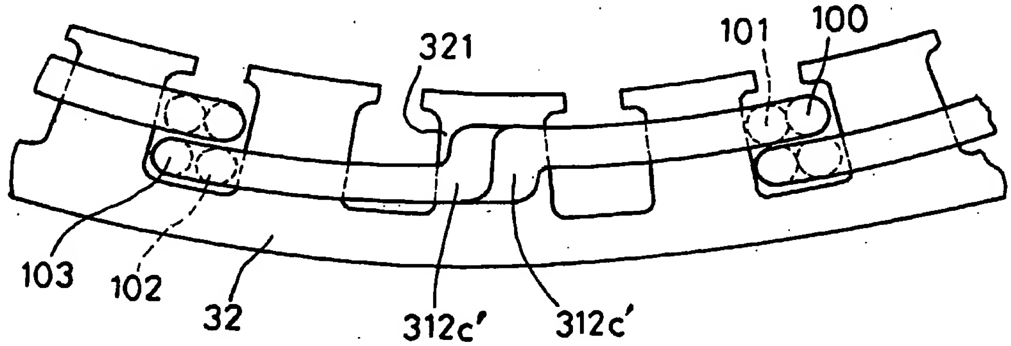
【図６】

Fig. 6



【図７】

Fig. 7



【図８】

Fig. 8